

CLAIMS

What is claimed is:

- 1 1. A composite particle, comprising:
2 an absorbent material formed into a particle; and
3 at least one performance-enhancing active added to the absorbent material.

- 1 2. A composite particle as recited in claim 1, wherein the absorbent material is a
2 liquid-absorbing material and is selected from a group consisting of: a mineral, fly
3 ash, absorbing pelletized material, perlite, silica, organic materials, and mixtures
4 thereof.

- 1 3. A composite particle as recited in claim 2, wherein the absorbent material is a
2 mineral selected from a group consisting of: bentonite, zeolite, montmorillonite,
3 diatomaceous earth, opaline silica, Georgia White clay, sepiolite, calcite,
4 dolomite, slate, pumice, tobermite, marls, attapulgite, kaolinite, halloysite,
5 smectite, vermiculite, hectorite, Fuller's earth, fossilized plant materials,
6 expanded perlite, gypsum, and mixtures thereof.

- 1 4. A composite particle as recited in claim 1, wherein the absorbent material
2 comprises sodium bentonite granules having a mean particle diameter of about
3 5000 microns or less.

- 1 5. A composite particle as recited in claim 4, wherein the absorbent material
2 comprises sodium bentonite granules having a mean particle diameter of about
3 3000 microns or less.

- 1 6. A composite particle as recited in claim 4, wherein the absorbent material
2 comprises sodium bentonite granules having a mean particle diameter in the range
3 of about 25 to about 150 microns.

- 1 7. A composite particle as recited in claim 1, wherein the added performance-
2 enhancing active includes at least one of an antimicrobial, an odor reducing
3 material, a binder, a fragrance, a health indicating material, a color altering agent,
4 a dust reducing agent, a nonstick release agent, a superabsorbent material,
5 cyclodextrin, zeolite, activated carbon, a pH altering agent, a salt forming
6 material, a ricinoleate and mixtures thereof.

- 1 8. A composite particle as recited in claim 1, wherein a performance-enhancing
2 additive is sprayed onto the particles.

- 1 9. A composite particle as recited in claim 1, wherein granules of a performance-
2 enhancing additive are dry-blended with the particles.

- 1 10. A composite particle as recited in claim 1, wherein the performance-enhancing
2 active comprises a boron-containing compound.

- 1 11. A composite particle as recited in claim 10, wherein the boron containing
2 compound is present in an antimicrobially effective amount, wherein the boron
3 containing compound is selected from a group consisting of borax pentahydrate,
4 borax decahydrate, boric acid, polyborate, tetraboric acid, sodium metaborate,
5 anhydrous, boron components of polymers, and mixtures thereof.

- 1 12. A composite particle as recited in claim 1, wherein the performance-enhancing
2 active inhibits the formation of odor, the active comprising a water soluble metal
3 salt selected from a group consisting of: silver, copper, zinc, iron, and aluminum
4 salts and mixtures thereof.

- 1 13. A composite particle as recited in claim 1, wherein the performance-enhancing
2 active is present in an effective amount.
- 1 14. A composite particle as recited in claim 1, wherein the performance-enhancing
2 active is activated carbon.
- 1 15. A composite particle as recited in claim 14, wherein the activated carbon is
2 present in about 5 weight percent or less based on a weight of the composite
3 particle.
- 1 16. A composite particle as recited in claim 14, wherein the activated carbon is
2 present in about 1 weight percent or less based on a weight of the composite
3 particle.
- 1 17. A composite particle as recited in claim 14, wherein the activated carbon has a
2 mean particle diameter of about 5000 microns or less.
- 1 18. A composite particle as recited in claim 14, wherein the activated carbon has a
2 mean particle diameter of about 1500 microns or less.
- 1 19. A composite particle as recited in claim 14, wherein the activated carbon has a
2 mean particle diameter of about 50 microns or less.
- 1 20. A composite particle as recited in claim 1, wherein the at least one performance-
2 enhancing active is substantially homogeneously dispersed throughout at least a
3 portion of the absorbent material.
- 1 21. A composite particle as recited in claim 1, wherein the at least one performance-
2 enhancing active is physically dispersed in at least one layer.

- 1 22. A composite particle as recited in claim 1, wherein the performance-enhancing
2 active is physically dispersed in pockets in the particle.
- 1 23. A composite particle as recited in claim 1, wherein the performance-enhancing
2 active is physically dispersed in at least one position selected from along surfaces
3 of the particle and contained within pores of the particle.
- 1 24. A composite particle as recited in claim 1, further comprising an absorbent core,
2 the absorbent material being coupled to the core.
- 1 25. A composite particle as recited in claim 1, further comprising a non-absorbent
2 core, the absorbent material being coupled to the core.
- 1 26. A composite particle as recited in claim 1, further comprising a hollow core, the
2 absorbent material being coupled to the core.
- 1 27. A composite particle as recited in claim 1, further comprising a core, the
2 absorbent material at least partially surrounding the core in the form of a shell,
3 wherein an average thickness of the shell is at least about four times an average
4 diameter of the core.
- 1 28. A composite particle as recited in claim 1, further comprising a core, the
2 absorbent material at least partially surrounding the core in the form of a shell,
3 wherein an average thickness of the shell is between about 1 and about 4 times an
4 average diameter of the core.
- 1 29. A composite particle as recited in claim 1, further comprising a core, the
2 absorbent material at least partially surrounding the core in the form of a shell,
3 wherein an average thickness of the shell is less than an average diameter of the
4 core.

- 1 30. A composite particle as recited in claim 1, further comprising a core, the
2 absorbent material at least partially surrounding the core in the form of a shell,
3 wherein an average thickness of the shell is less than about one-half an average
4 diameter of the core.
- 1 31. A composite particle as recited in claim 1, further comprising a heavy core
2 comprised of a material having a density higher than a density of the absorbent
3 material, the absorbent material being coupled to the core.
- 1 32. A composite particle as recited in claim 1, further comprising a lightweight core
2 comprised of a material having a density lower than a density of the absorbent
3 material, the absorbent material being coupled to the core.
- 1 33. A composite particle as recited in claim 1, further comprising a core comprised of
2 a pH-altering material, the absorbent material being coupled to the core.
- 1 34. A composite particle as recited in claim 1, wherein the particle has a bulk density
2 of less than about 90% of a bulk density of a generally solid particle containing
3 the absorbent material alone.
- 1 35. A composite particle as recited in claim 1, wherein the particle has a bulk density
2 of less than about 70% of a bulk density of a generally solid particle containing
3 the absorbent material alone.
- 1 36. A composite particle as recited in claim 1, wherein the particle has a bulk density
2 of less than about 50% of a bulk density of a generally solid particle containing
3 the absorbent material alone.
- 1 37. A composite particle as recited in claim 1, further comprising multiple cores, the
2 absorbent material being coupled to the cores.

- 1 38. A composite particle as recited in claim 1, wherein the composite particle has a
2 hydraulic conductivity value of about 0.25 cm/s or less.
- 1 39. A composite particle as recited in claim 1, wherein the composite particle exhibits
2 reduced sticking to a container in which the composite particle rests when the
3 particle is wetted relative to a generally solid particle under substantially similar
4 conditions.
- 1 40. A composite particle as recited in claim 1, wherein the composite particle has a
2 moisture content of less than about 25% by weight based on a weight of the
3 composite particle.
- 1 41. A composite particle as recited in claim 1, wherein the composite particle has a
2 moisture content of less than about 15% by weight based on a weight of the
3 composite particle.
- 1 42. A composite particle as recited in claim 1, wherein the composite particle has a
2 moisture content of less than about 10% by weight based on a weight of the
3 composite particle.
- 1 43. A composite particle as recited in claim 1, wherein the composite particle is
2 capable of absorbing a weight of water equaling at least about 90 percent of a
3 weight of the composite particle.
- 1 44. A composite particle as recited in claim 1, wherein the composite particle is
2 capable of absorbing a weight of water equaling at least about 75 percent of a
3 weight of the composite particle.

- 1 45. A composite particle as recited in claim 1, wherein the composite particle is
2 capable of absorbing a weight of water equaling at least about 50 percent of a
3 weight of the composite particle.
- 1 46. A composite particle as recited in claim 1, wherein the composite particle has a
2 dusting attrition value of at most about 15% as measured by ASTM method E-728
3 Standard Test Method for Resistance to Attrition of Granular Carriers and
4 Granular Pesticides.
- 1 47. A composite particle as recited in claim 1, wherein the composite particle has a
2 malodor rating below about 15 as determined by a Malodor Sensory Method.
- 1 48. A composite particle as recited in claim 1, wherein the composite particle exhibits
2 noticeably less odor after four days from contamination with animal waste as
3 compared to a generally solid particle of the absorbent material alone under
4 substantially similar conditions.
49. A composite particle as recited in claim 1, wherein the composite particle has
been formed by an agglomeration process.
- 1 50. A composite particle as recited in claim 49, wherein the agglomeration process is a
2 pan agglomeration process.
- 1 51. A composite particle as recited in claim 49, wherein the agglomeration process is
2 at least one of a high shear agglomeration process, a low shear agglomeration
3 process, a high pressure agglomeration process, a low pressure agglomeration
4 process, a rotary drum agglomeration process, a fluid bed agglomeration process,
5 a mix muller process, a roll press compaction process, a pin mixer process, a

6 batch tumble blending mixer process, an extrusion process and a fluid bed
7 process.

1 52. A composite particle as recited in claim 1, wherein the composite particle has a
2 bulk density of about 1.5 grams per cubic centimeter or less.

1 53. A composite particle as recited in claim 1, wherein the composite particle has a
2 bulk density of 0.85 grams per cubic centimeter or less

1 54. A composite particle as recited in claim 53, wherein the composite particle has a
2 bulk density of between about 0.25 and 0.85 grams per cubic centimeter .

1 55. A composite particle as recited in claim 1, wherein the particle has a liquid
2 absorbing capability of from about 0.6 to about 2.5 liters of water per kilogram of
3 particles.

1 56. A composite particle as recited in claim 1, wherein the particle is used in at least
2 one of an animal litter product, a laundry product, a home care product, a water
3 filtration product, an air filtration product, a fertilizer product, an iron ore
4 pelletizing product, a pharmaceutical product, an agricultural product, a waste and
5 landfill remediation product, a bioremediation product, and an insecticide product.

1 57. Multiple composite particles as recited in claim 1, wherein substantially each
2 particle includes the active.

1 58. Multiple composite particles as recited in claim 1, wherein substantially each
2 particle includes multiple actives.

- 1 59. Multiple composite particles as recited in claim 1, wherein some of the particles
2 include a first active, and other particles contain a second active, the second active
3 being different than the first active.
- 1 60. Multiple composite particles as recited in claim 1, wherein at least about 80% of
2 the particles are retained in a clump upon addition of an aqueous solution.
- 1 61. Multiple composite particles as recited in claim 1, wherein at least about 90% of
2 the particles are retained in a clump upon addition of an aqueous solution.
- 1 62. Multiple composite particles as recited in claim 1, wherein at least about 95% of
2 the particles are retained in a clump after 6 hours upon addition of 10 ml of cat
3 urine.
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- 1 63. Composite particles having improved clumping characteristics, comprising:
2 granules of an absorbent material formed into particles, each particle having areas
3 of more-water-soluble absorbent material and less-water-soluble absorbent
4 material relative to each other, the areas of more-water-soluble absorbent
5 material being capable of dislodging from the associated particle when
6 wetted and becoming entrained between adjacent particles, the entrained
7 absorbent material forming a bond between the adjacent particles.
- 1 64. Composite particles as recited in claim 63, wherein the absorbent material is
2 sodium bentonite having a mean particle diameter of about 1000 microns or less.

1 65. Composite particles as recited in claim 64, wherein the sodium bentonite has a
2 mean particle diameter in the range of about 25 to about 150 microns.

1 66. Composite particles as recited in claim 63, further comprising a performance-
2 enhancing active, wherein the performance-enhancing active includes at least one of an
3 antimicrobial, an odor reducing material, a binder, a fragrance, a health indicating
4 material, a color altering agent, a dust reducing agent, a nonstick release agent, a
5 superabsorbent material, cyclodextrin, zeolite, activated carbon, a pH altering agent, a
6 salt forming material, a ricinoleate and mixtures thereof.

1 67. Composite particles as recited in claim 63, wherein a performance-enhancing
2 additive is sprayed onto the particles.

1 68. Composite particles as recited in claim 63, wherein granules of a performance-
2 enhancing additive is dry-blended with the particles, with or without addition of a
3 binder.

1 69. Composite particles having improved odor reducing characteristics, comprising:
2 granules of an absorbent material; and
3 granules of an odor reducing active added to the absorbent material;
4 wherein pores are formed between the granules of the absorbent material such that
5 at least some of the granules of the odor reducing active positioned
6 towards a center of the particle are in fluid or gaseous communication with
7 an outer atmosphere surrounding the particle.

1 70. A composite particle as recited in claim 69, wherein the odor reducing active is
2 activated carbon.

- 1 71. A composite particle as recited in claim 70, wherein the activated carbon is
2 present in about 5 weight percent or less based on a weight of the composite
3 particle.
- 1 72. A composite particle as recited in claim 70, wherein the activated carbon is
2 present in about 1 weight percent or less based on a weight of the composite
3 particle.
- 1 73. A composite particle as recited in claim 70, wherein the activated carbon has a
2 mean particle diameter of about 500 microns or less.
- 1 74. A composite particle as recited in claim 70, wherein the activated carbon has a
2 mean particle diameter in the range of about 25 to 150 microns.
- 1 75. A composite particle as recited in claim 69, wherein the odor reducing active
2 comprising a water soluble metal salt selected from a group consisting of: silver,
3 copper, zinc, iron, and aluminum salts and mixtures thereof.
- 1 76. A method for forming composite particles, comprising:
2 adding granules of an absorbent mineral to an agglomerator, the granules of
3 absorbent material having a particle size smaller than about 1000 microns;
4 adding granules of a performance-enhancing active to the agglomerator;
5 adding water to the agglomerator; and
6 agglomerating the mixture for forming particles of absorbent material and
7 performance-enhancing active.

- 1 77. A method as recited in claim 76, further comprising adding granules of a core
2 material to the agglomerator, the absorbent material and at least one performance-
3 enhancing active surrounding the granules of the core material.
- 1 78. A method as recited in claim 76, wherein the performance-enhancing active
2 includes at least one of an antimicrobial, an odor reducing material, a binder, a
3 fragrance, a health indicating material, a color altering agent, a dust reducing
4 agent, a nonstick release agent, a superabsorbent material, cyclodextrin, zeolite,
5 activated carbon, a pH altering agent, a salt forming material, a ricinoleate and
6 mixtures thereof.
- 1 79. A method as recited in claim 76, further comprising drying the particles to a
2 desired state, wherein the particles have a bulk density of from about 0.15 to
3 about 1.5 grams per cubic centimeter and a liquid absorbing capability of from
4 about 0.6 to about 2.5 liters of water per kilogram of particles.
- 1 80. An animal litter, comprising:
2 an absorbent material formed into a particle;
3 activated carbon added to the absorbent material; and
4 optionally at least one other performance-enhancing active added to the absorbent
5 material.
- 1 81. The animal litter as recited in claim 80, wherein the activated carbon is present in
2 about 1 weight percent or less based on a weight of the animal litter.
- 1 82. A method for preparing a litter box for use by animals, comprising:

2 selecting a receptacle with a closed bottom, a plurality of interconnected generally
3 upright side walls forming an open top and defining an inside surface; and
4 adding a litter material of absorbent composite particle form to the box.

1 83. A method as recited in claim 82, wherein the litter material further includes a
2 performance-enhancing active mixed with the particles.

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